REMARKS

Favorable reconsideration and allowance of this application are requested.

1. Discussion of Claim Amendments

By way of the amendment instructions above, claim 6 has been amended so as to employ an expression commensurate with that employed in pending claim 36.

Following entry of this amendment, therefore, claims 1, 3-8, 11-13, 16 and 18-48 will remain pending herein for consideration.

2. Response to 35 USC §112 Rejection

The amendment made to pending claim 6 is believed to render moot the Examiner's rejection advanced under 35 USC §112, second paragraph against claims 6-8, 11 and 12.

3. Response to 35 USC §102(b) Rejection

Prior claims 1, 3-4, 13, 16 and 43 attracted a rejection under 35 USC §102(b) as allegedly being anticipated by Taketo (JP 10-340846). In this regard, the Examienr asserts that:

> "…since the amount of additive is being monitored [in Taketo], it would be apparent that the amount of additive present can either be very small or large, as cited in claim 4 of the present invention." (Office Action at page 2, ultimate line bridging page 3.)

Applicants respectfully disagree. Specifically, Taketo neither explicitly nor implicitly discloses that the amount of additive is such that the refractive index (RI) of the immersion fluid is adjusted by ***at least 1%***.

Taketo discloses a continuous method of calibrating the performance of the optical system used in immersion photolithography. In particular, Taketo addressed the problem associated with the mechanical adjustment systems which were unable to correct imaging performance without causing vibration.

As indicated in the English abstract, the solution was achieved by Taketo by adjusting the RI of the immersion liquid to correct the imaging performance. However, in contrast to the Examiner's assertions, Taketo teaches that the increase in RI is necessarily very small -- i.e., about 0.1% or less.

The following disclosures in Taketo all confirm that the increase in the RI taught is very small. In particular, Taketo teaches that, for the purposes of continual calibration of the optical system, the magnitude of the required correction of the RI is very small and the means for facilitating this very small correction in RI is only suitable for this purpose.

Required magnitude of correction

Both the optical system and the immersion liquid are prone to changes In their refractive index as a result of changing environment conditions. Taketo teaches that variations in the refractive index of the optical system may be compensated by continually adjusting the RI of the immersion liquid to correct for changes in the optical system (i.e., lens) due to modification of light conditions [paragraph 0009, 0018, 0027 and 0034], temperature change and atmospheric pressure change [paragraph 0047]. An aberration test is used to monitor the projection optical system and the results of this test form the basis for adjusting the RI [paragraph 0047].

The RI of the immersion liquid (i.e. water) varies more with temperature fluctuations than the optical system (i.e. fused silica).[1] However, as the immersion fluid is constantly circulated, the residence time of the immersion liquid exposed to the light source is low, such that any temperature variation of the immersion fluid would be expected to be in the magnitude of one or two degrees. By contrast, the optical system is fixed and is prone to larger temperature changes depending upon the lighting conditions and the absorption of light by the material making up the optical system, such as fused silica. The change in the RI for fused silica is in the order of $2x10^{-5}/^{0}C$,[2] and thus even for an improbable $100^{0}C$ change in temperature, the refractive index of the fused silica (n = 1.560841 at 220C under a nitrogen atmosphere, at 760 mm Hg at a wavelength of 193nm) will only change the refractive index by 0.002 or about 0.1%. This is about an order of magnitude lower than the change of RI required by the pending independent claims 1 and 43 of the present application.

Means for correction

The means of adjusting the refractive index disclosed in Taketo only facilitates very small adjustments of the RI. For instance, the use of electrodes to generate oxygen, hydrogen and chlorine gas and thereby increase the concentration of hydrogen chloride in solution may only be practically used for very small adjustments to the RI. Further the generation of hydrogen chloride, which has a corrosive effect on the semiconductor wafer, necessitates that the increase in concentration of hydrogen chloride, and hence the increase in RI, is very small. This fact is alluded to in paragraph

[1] See in this regard the enclosed copies of "Eigenschaften Der Materie in Inhren Aggregatzuständen – Optische Konstanten", pages 5-565, 5-566 and 5-569, Springer-Verlag, (1962) which includes data relating to the influence of temperature of the refractive index of water.

[2] See the attached product specification sheet, HPFS® Fused Silica ArF Grade, Corning Inc. September 30, 2003, a fused silica which is used in immersion photolithography optical systems and which lists certain properties thereof including the differential temperature coefficients of the RI.

0029, in reference to the fact that ethyl alcohol does not dissolve the resist layer of the wafer.

The alterative additive disclosed in Taketo is ethyl alcohol. The addition of ethyl alcohol to increase the refractive index of pure water, as indicated in paragraph 0029, (water. 1.44 (193 nm); ethyl alcohol 1.47 (193 nm), 2% higher) indicates that there is only a marginal difference in refractive index, such that about 50 % w/w of ethyl alcohol would be required to raise the refractive index of the solution by 1%. In such circumstances, the ethyl alcohol becomes a major component of the immersion liquid, rather than an additive thereof. Further, for reasons of practicalities, it would not be feasible for a continual calibration system to require the replacement of at least half the immersion fluid with an additive, as the time delays in changing volume of immersion fluid in itself would be unworkable. As illustrated in Taketo's Figure 3 and paragraphs [0030] to [0035], the adjustments of the amounts of pure water or additive are on a small scale, such that the level of the liquid and the liquid discharge are carefully monitored. The addition of large proportions of calibration fluids (water or additive) would inherently compromise the accuracy of the adjustment, as the RI of the discharge liquid would change as it mixed with the incoming additive. However, with small adjustments in RI, the assumption that the RI of the discharge liquid is constant remains valid.

Accordingly, for the abovementioned reasons, Taketo does not disclose (explicitly or implicitly) a method of producing microchips in which the RI of the immersion fluid is adjusted ***by at least 1%*** as defined in independent claims 1 and 43 of the present invention. Thus, such independent claims cannot be anticipated by Taketo under 35 USC §102(b). For similar reasons, claims 3, 4 and 13 are also not anticipated by Taketo.

In regard to the rejection of claim 16, the examiner states (under paragraph 4 of the Office Action) that Taketo discloses a recycling system used to recycle the immersion liquid used in the exposure process. However, the figures and text in Taketo only disclose the use of an exhaust pipe to discharge liquid to enable more liquid containing additives to be added (paragraphs [0031] and [0032] of Taketo). Consequently, applicants submit that claim 16 is also not anticipated by Taketo.

4. Response to 35 USC §103(a) Rejections

A. Taketo in view of Chen (US 2004/0152011)

Taketo does not disclose a method of producing microchips in which the RI of the immersion fluid is adjusted by at least 1%. Indeed, as discussed above, the purpose of the RI adjustment in Taketo directs the person of ordinary skill to make very small adjustment in RI to overcome variations in the Ri of the optical system. Thus, the difference between Taketo in view of Chen is that such combination does not disclose at least:

- a method of producing microchips in which the RI of the immersion fluid is adjusted by at least 1%; and
- that the additive is insoluble in the immersion fluid.

Chen relates to reversible photo-bleachable material. The nano-particles described in Chen are semi-conductive (paragraph [0014]) in which electron and hole pairs corresponding to certain photon energy are excited to form excitons, thereby bleaching the nano-particles (paragraph [0015]). The semiconductor nano-particles of Chen are reversible, such that the nano-particles recover their original optical property (i.e., opaque) after the light has been turned off (paragraph [0016]). Due to the functionality of the semi-conductor nano-particles, specific nano-particles are required to be used at different wavelengths, in which only MgZnO is disclosed as being suitable

(paragraph [0027]) for use at 193 nm. In the formation of semi-conductors, the nano-particles are used as a contrast enhance material, which enables a broad light beam to produce a narrower image, as illustrated in Figures 4a-d.

Chen is fundamentally different to the use of nano-particles in the present invention, in which the nano-particles are "bleached", rather than "bleachable". Indeed, by definition the nano-particles described in Chen would be unsuitable for use as an immersion liquid due to their requirement to absorb light, rather than transmit light (see for example page 6, lines 29-32 of the present application).

Therefore, even if the person of ordinary skill would be directed by Taketo to use additives to increase the refractive index of the immersion fluid by more than 1% (an assumption which applicants emphatically dispute for the reasons already noted), the teachings of Chen would be considered not relevant to solving this problem. Chen does not discuss the RI of the nano-particles, nor that the RI may be increased by adding the nano-particles to an immersion fluid. Indeed, Chen is directed towards the energy absorption and desorption capacity of specific nano-particles at specific wavelengths which form part of a semi-conductive composite. Chen is not directed to immersion photolithography; Chen is not directed to the use of nano-particles to increase the refractive index of an immersion fluid and Chen is not directed towards the refractive index properties of nano-particles.

Accordingly, applicants submit that pending claims 5-8, 11, 12 and 46 are patentably non-obvious in light of Taketo in view of Chen.

B. Taketo in view of Kunz (US 2005/0164522)

The Examiner relies on the disclosure that Kunz discloses fluids to be used in immersion lithography processes comprising 1 to 20 carbons. However, the paragraphs referenced by the examiner relate to the definition of "aliphatic" (paragraph [0050])

compounds which are impurities, such as derivatives of cyclopropane or cyclobutane (paragraph [0099]). Further, the term "aliphatic" is not mentioned again in the specification, indicating that the inclusion of such a definition is at best redundant. Even if some derivatives of cyclopropane or cyclobutane may be classified as alkanes, the person of ordinary skill is taught by Kunz that these compounds are impuilties and that their presence is detrimental.

Thus, the applicants respectfully submit that Kunz does not disclose fluids to be used in immersion lithography processes comprising 1 to 20 carbons.

Accordingly, applicants submit that rejected claims 18, 19, 30-34, 44 and 45 are patentably non-obvious in light of Taketo in view of Kunz.

C. Taketo in view of Chen and Kunz

The discussions above are equally germane to the inappropriateness of combining Chen and Kunz with Taketo for the purpose of advancing a rejection under 35 USC §103(a). Therefore, for the reasons advocated above, the combination of Taketo in view of Chen and Kunz does not disclose all of the features recited by claims 20-29, 35-42, 47 and 48, nor any direction to arrive at such claimed features.

Accordingly, applicants submit that rejected claims 20-29, 35-42, 47 and 48 are patentably non-obvious over Taketo in view of Chen and Kunz.

4. Information Disclosure Statement

Pursuant to 37 CFR §1.97(c), the Examiner's attention is directed to the publications listed on the form a concurrently filed Information Disclosure Statement (IDS). A copy of each non-US patent publication is also attached to the IDS along with the fee required by Rule 97(c). In addition, the evidentiary publications noted in

footnotes 1 and 2 above are also listed. Consideration of the same during prosecution of this application is requested.

6. Fee Authorization

The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Account No. 14-1140.

Respectfully submitted,

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